

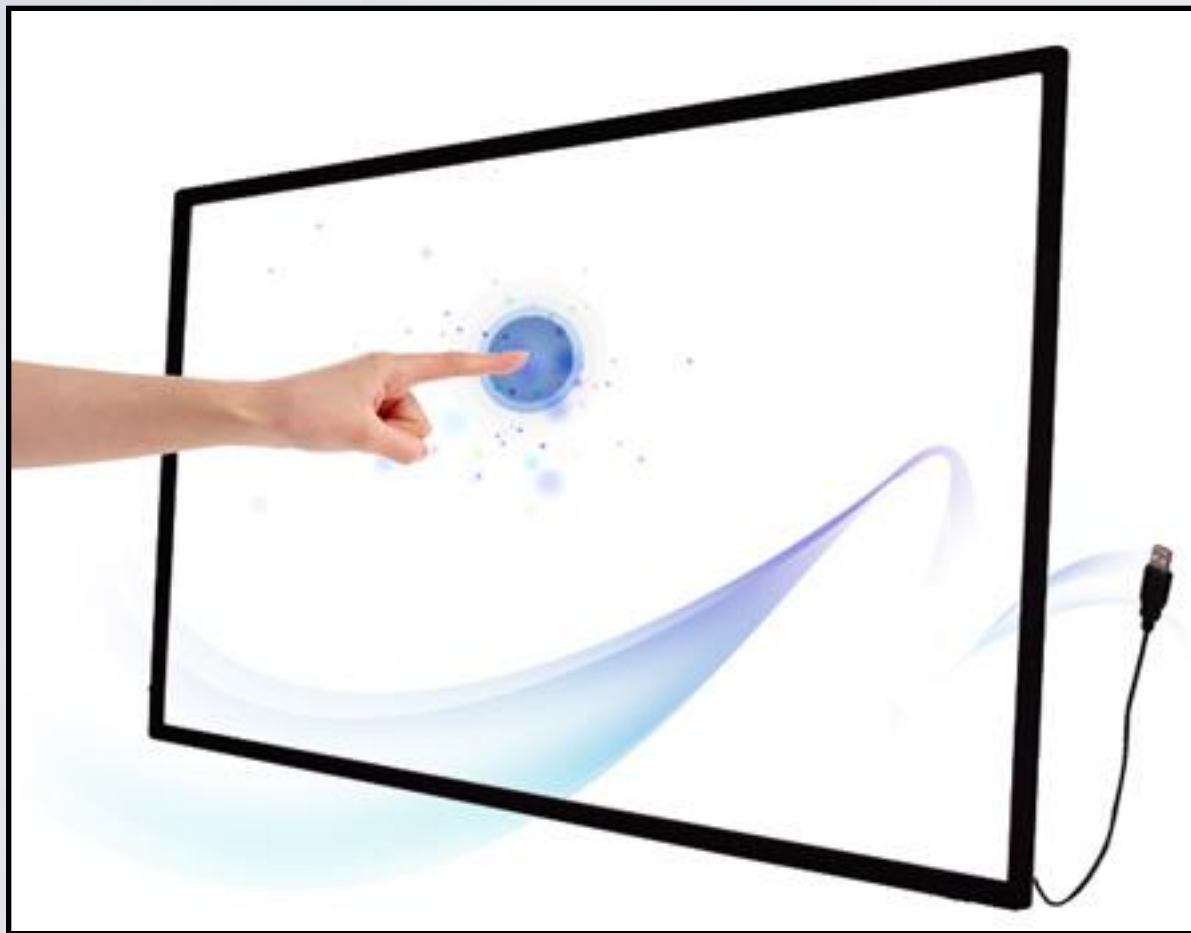
# Touch Screen Technology

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# What is a touch screen?



- An electronic visual **display that locates the coordinates of** a users touch within display area
- Works independently of what is being displayed on screen

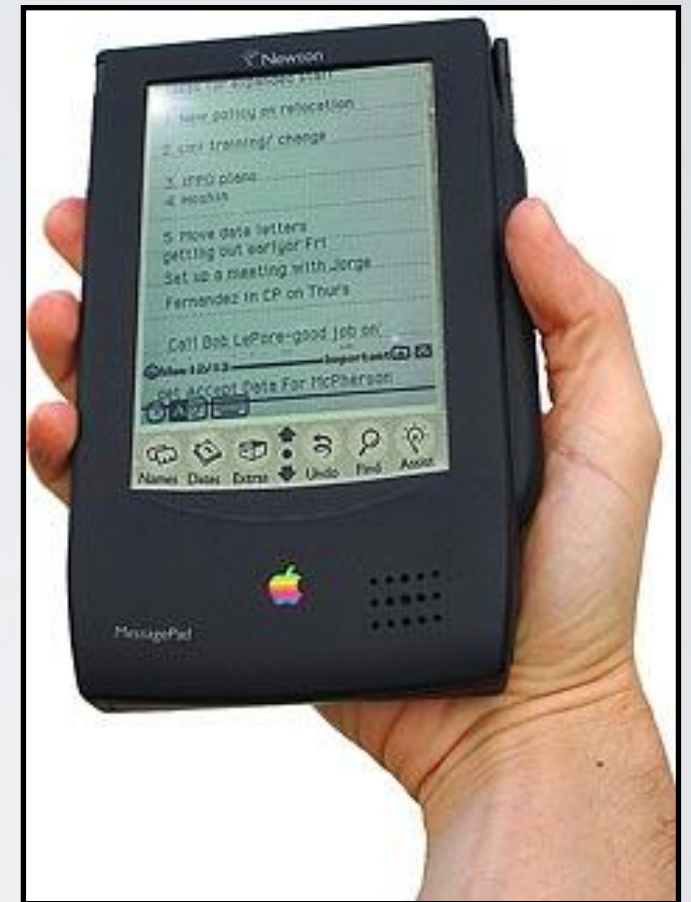
# When is it Applicable?

- It allows users to **interact directly** with what is being displayed, rather than indirectly using a mouse or keyboard
- Can be used without any **intermediate device**
- Found in modern **smartphones, video games, kiosks, navigation systems, etc. . .**



# Brief History

- Invented by E.A. Johnson (Royal Radar Est.) around 1965 for air traffic control
- HP-150 home computer using infrared technology in 1983
- 1993 Apple's Newton and IBM's Simon
- 2002 Microsoft's Windows XP Tablet
- 2007 Apple's iPhone (Multi-touch)

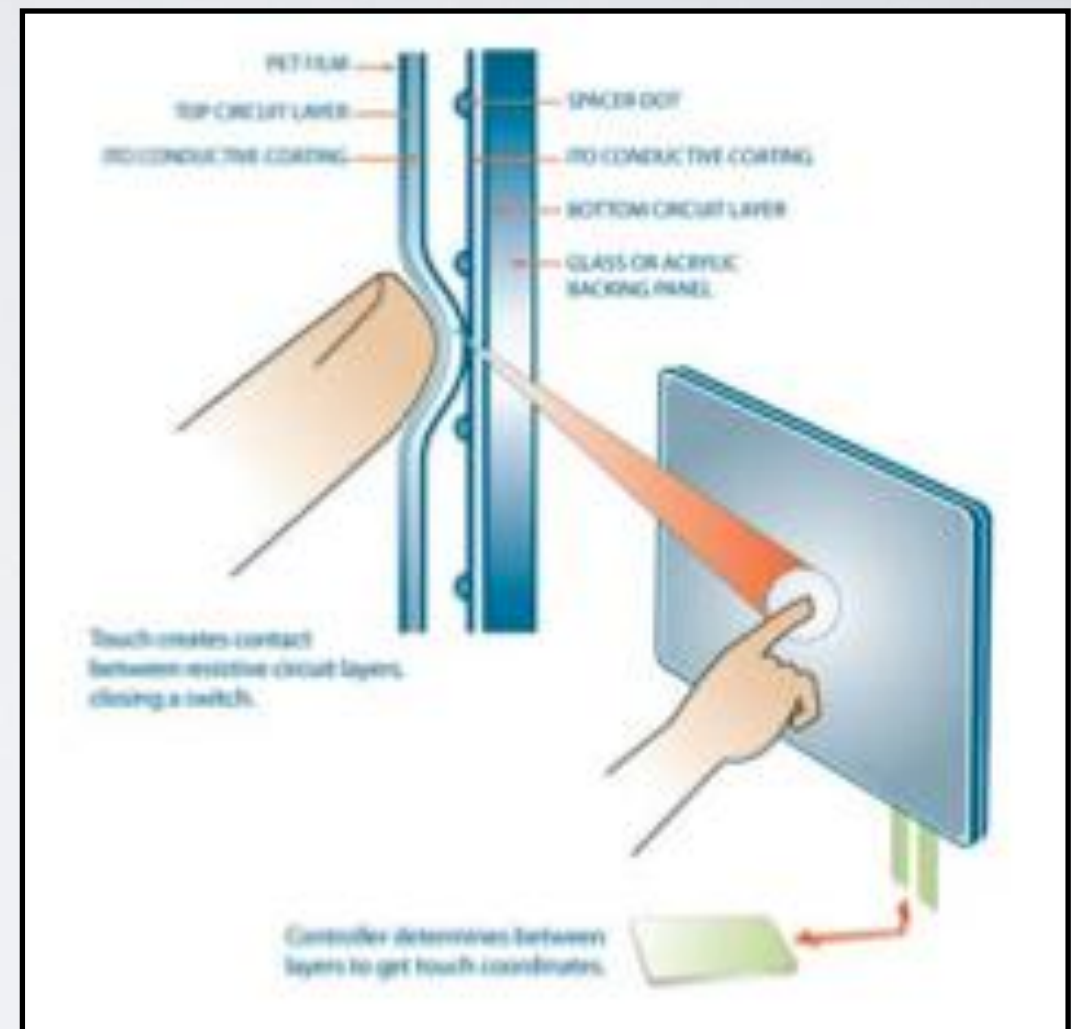


# Touch Screen Technology

- Four different technologies used to make touch screens today:
  - Resistive
  - Capacitive
  - Surface Acoustic Wave (SAW)
  - Infrared LED or Optical

# 1. Resistive Touch Screens

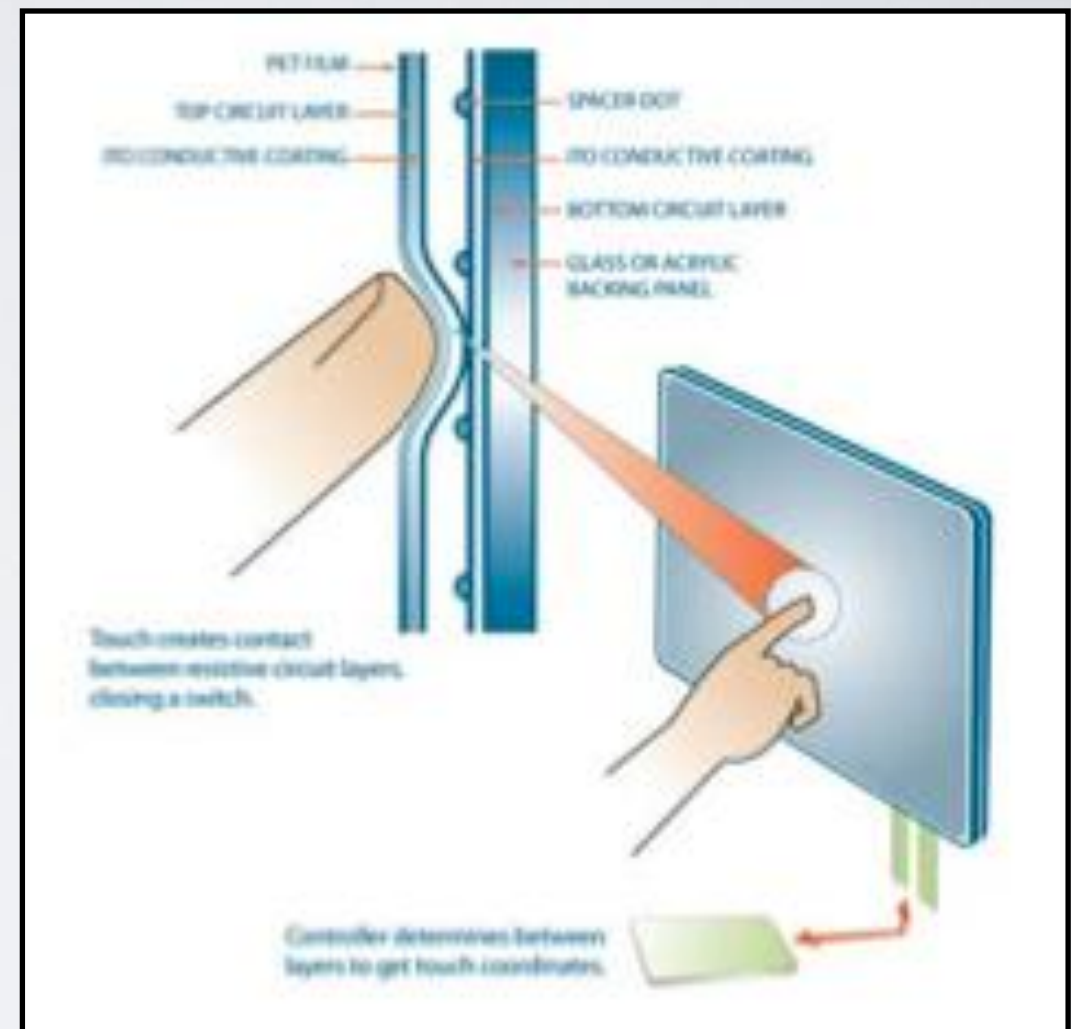
- Two layers of conductive material
- Touch creates contact between resistive layers completing circuit





# 1. Resistive Touch Screens

- Voltage in circuit changes based on position
- Controller determines location based on voltages
- Any material can trigger sensors



# 1. Why Resistive?

- **Advantages:**

- Cost-effective and low power Requirements
- Activated by any object
- Accurate

- **Disadvantages:**

- Polyester surface can be damaged
- Only 75% light transmission
- Lower endurance (~35 million touches)

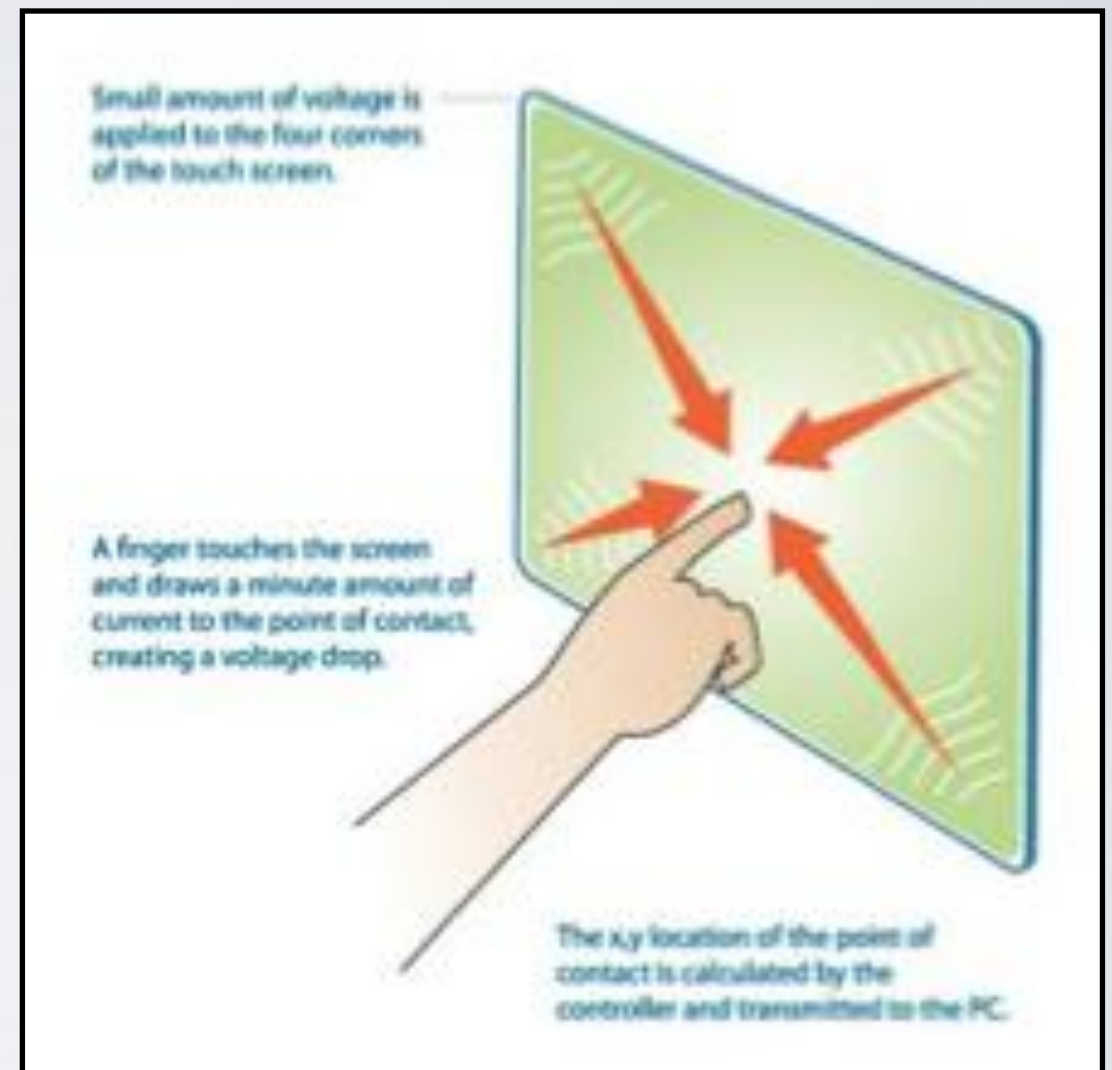


# 1. Resistive Summary

- 8" resistive touch screen will cost about \$60
  - 4 and 5 wire touch screens don't need controllers
  - For those that do, they cost less than \$5
- Any object can be used to activate the screen
- Not able to register multiple touches
- ~75% of light is transferred through (12.5% per layer)

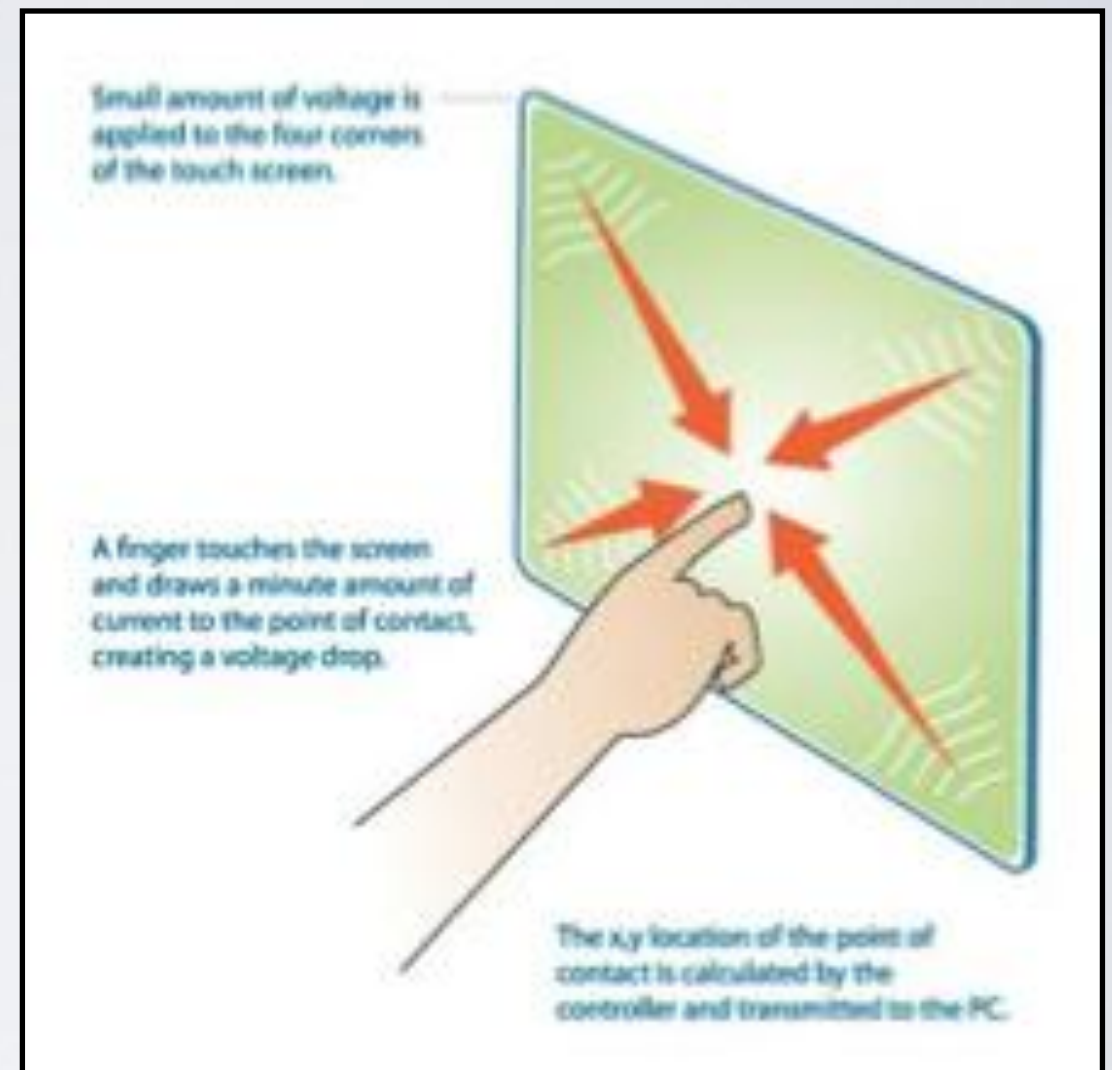
## 2. Capacitive Touch Screens

- Glass panel with conductive layer (Indium Tin Oxide)
- Small amount of voltage applied to four corners of touch screen



## 2. Capacitive Touch Screens

- Touch draws minute amount of current creating voltage drop
- Coordinates of point of contact calculated by controller



## 2. Why Capacitive?

- **Advantages:**

- Durable surface material
- High endurance (~255 million touches)
- Very accurate
- Good optical quality

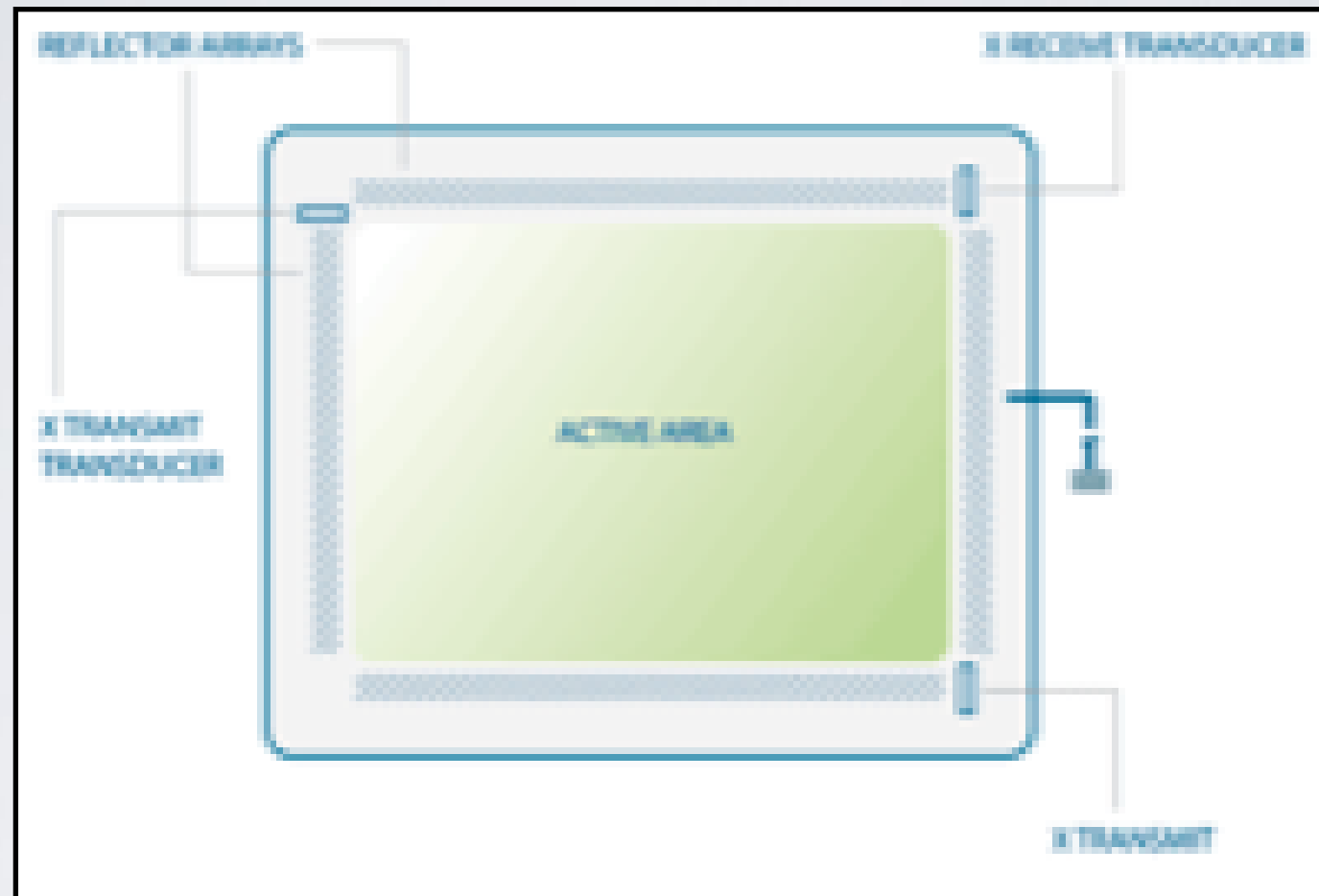
- **Disadvantages:**

- Triggered only by bare finger or active stylus

## 2. Capacitive Summary

- 8" capacitive touch screen costs about \$100
  - Controllers can be bought for less than \$5
- Only conductive objects can be used to activate
- Able to register multiple touches
- ~88% of light is transferred through

# 3. Surface Acoustic Wave Touch Screens

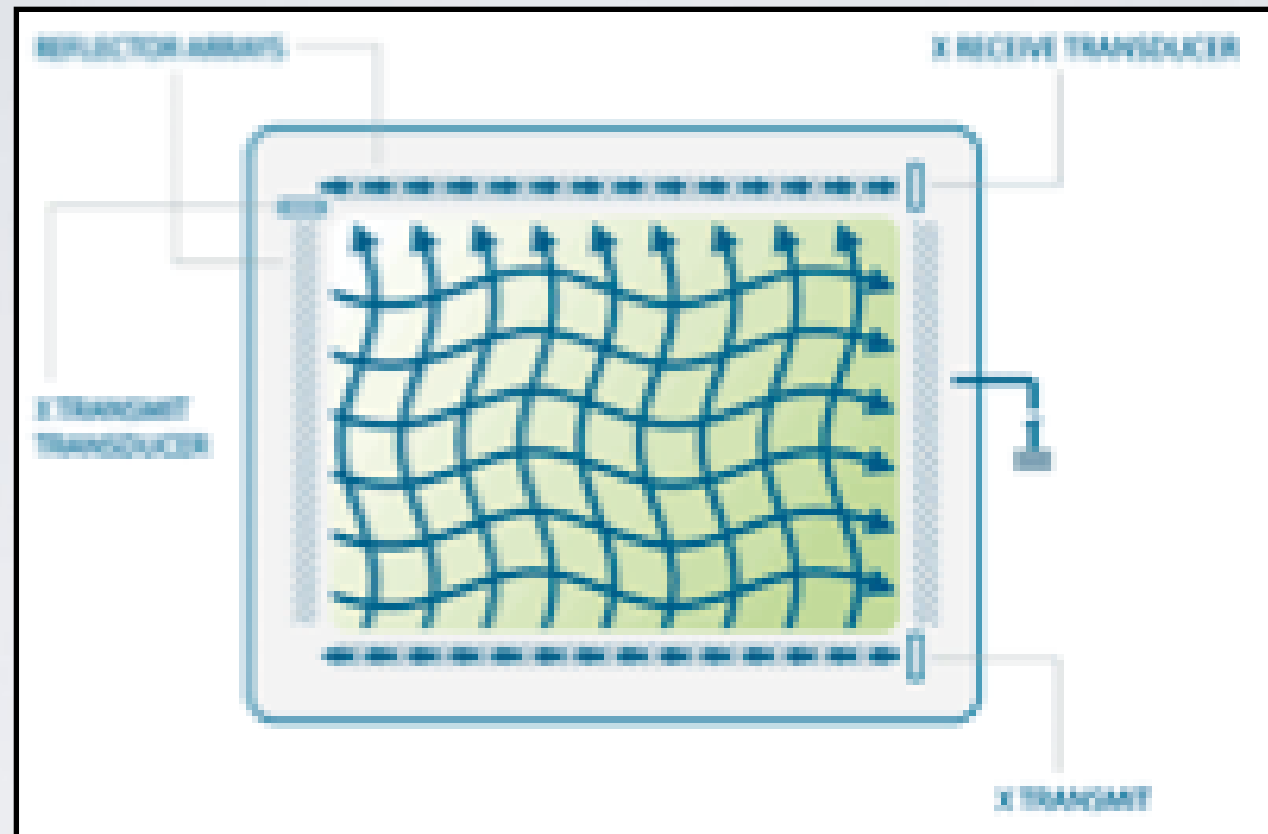


[2]

- Surface consists of glass overlay with transmitting and receiving transducers



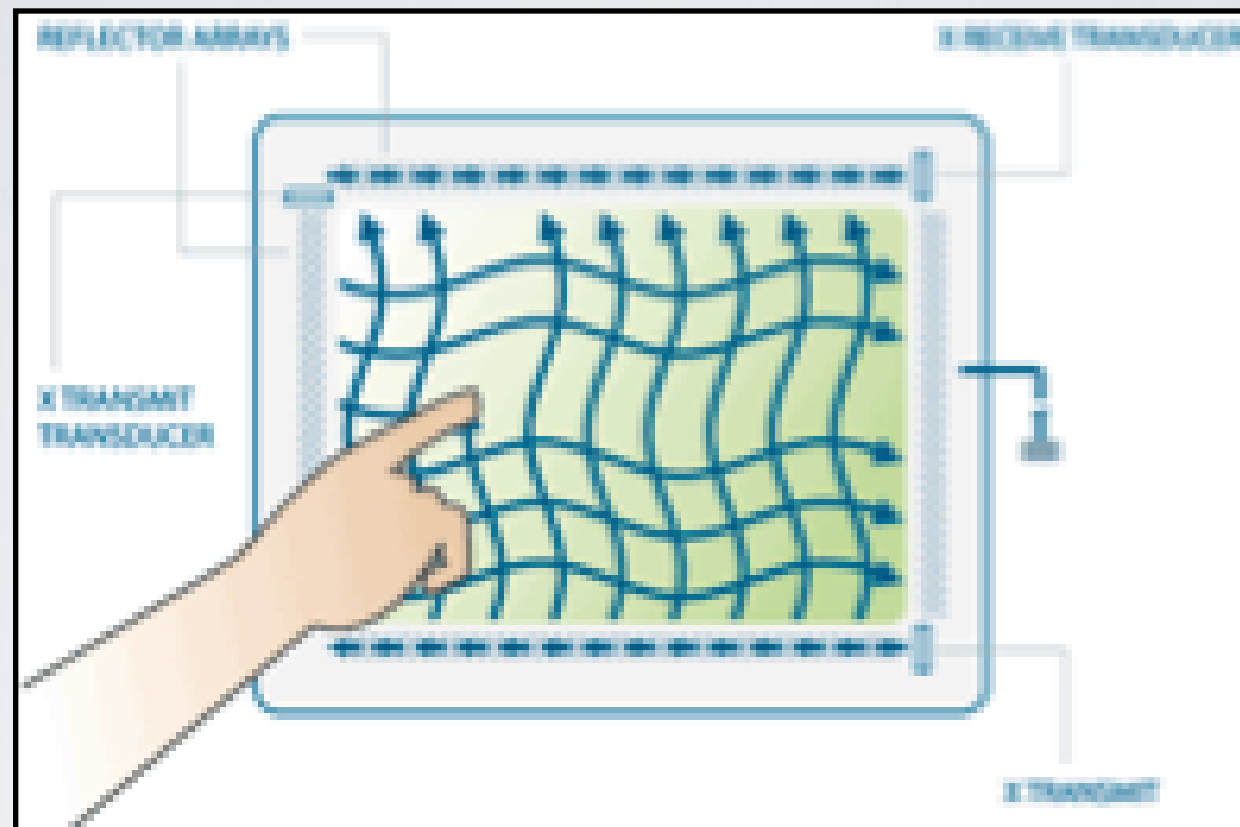
# 3. Surface Acoustic Wave Touch Screens



[2]

- Electrical signals sent to the transmitting transducers converts to ultrasonic waves
- Waves are directed across screen by reflectors then directed to receiving transducers

# 3. Surface Acoustic Wave Touch Screens



[2]

- When finger touches screen it absorbs waves
- Received values are compared to stored digital maps to calculate x and y coordinates

# 3. Why SAW?

- **Advantages:**

- Best optical quality
- High surface durability and seal
- Activated by multiple sources

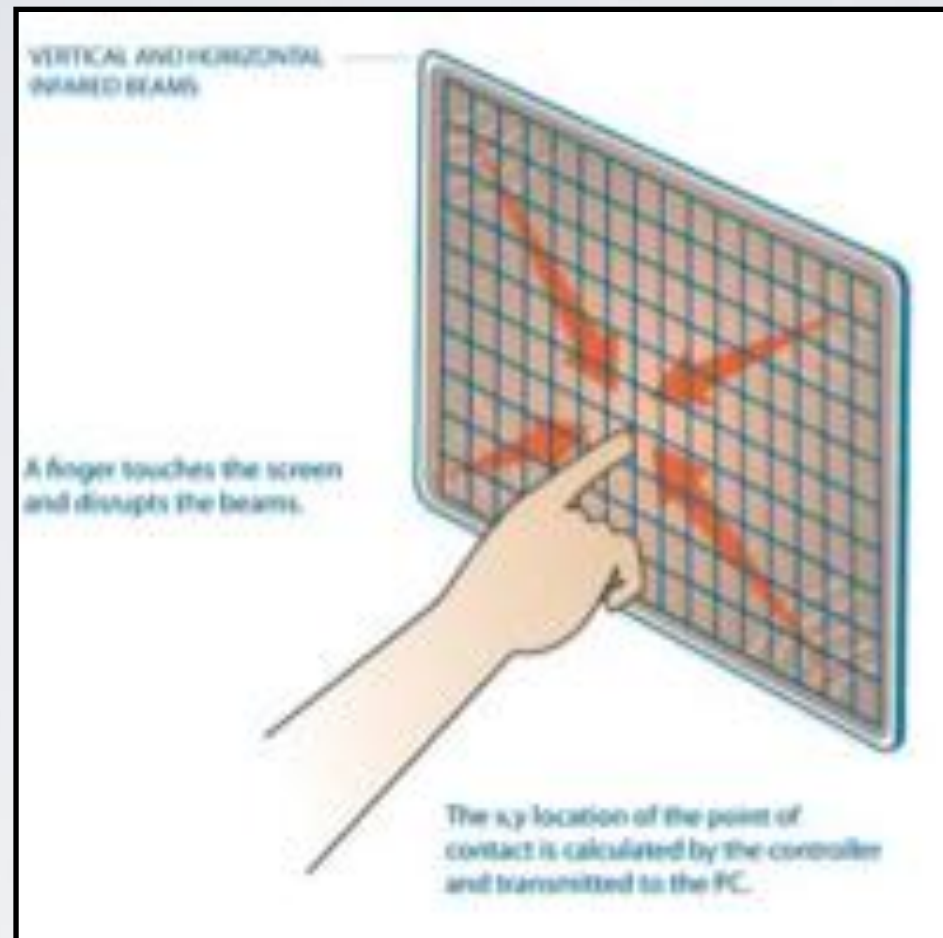
- **Disadvantages:**

- Expensive
- Contaminates on screen can cause false-touches

# 3. Surface Acoustic Wave Summary

- We were not able to find prices for individual screens
- Any object can be used to activate the screen
- Able to register multiple touches
- ~100% of light is transferred through

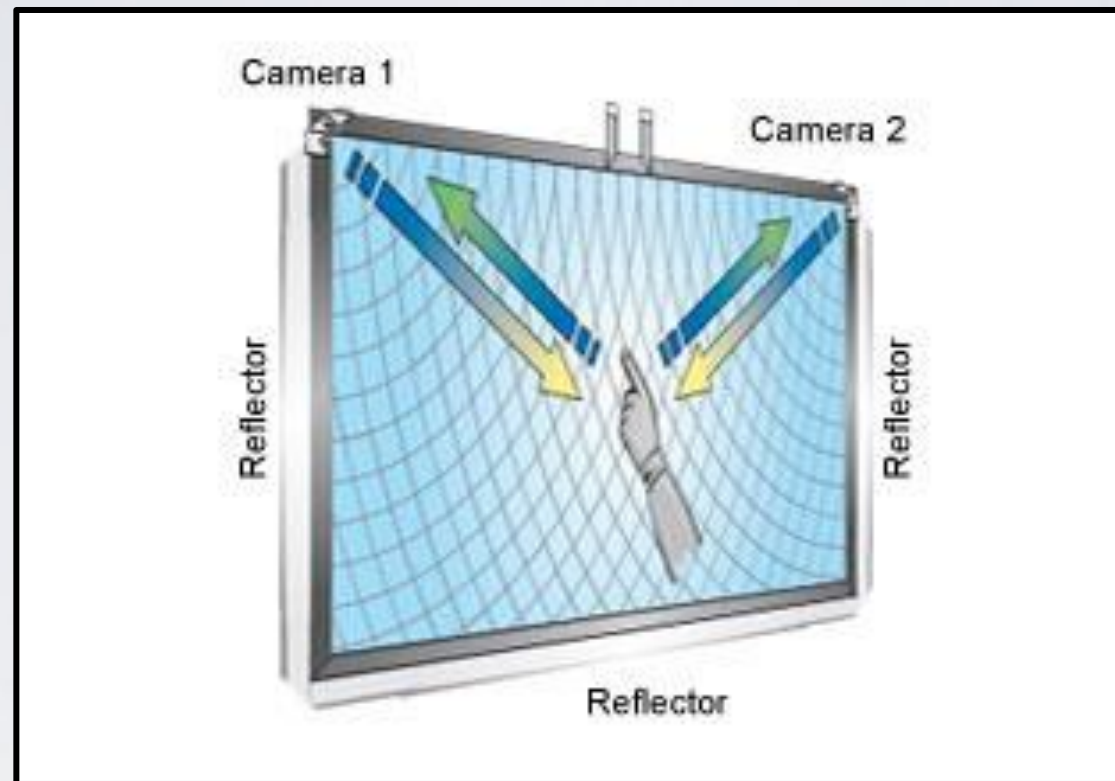
# 4. Infrared/Optical Touch Screens



[2]

- Uses infrared LEDs and matching photodetectors
- Touching screen interrupts LEDs

# 4. Infrared/Optical Touch Screens



[8]

- Cameras detect reflected LED caused by touch
- Controller able to calculate coordinates from camera data



# 4. Infrared/Optical Touch Screens

- **Advantages:**
  - High optical clarity
  - Durable surface
  - Supports multi-touch
  - Can scale to large sizes
- **Disadvantages:**
  - Expensive
  - Cameras can get out of alignment

# 4. Infrared/Optical Summary

- 8" infrared touch screen costs about \$160
- Any object can be used to activate the screen
- Able to register multiple touches
- ~100% of light is transferred through

Type	Examples	Price <small>(DigiKey)</small>	Tool for Input	Multi-touch
Resistive [1]	 <p>Samsung Messenger Touch, Samsung Instinct, HTC Touch Diamond, LG Dare</p>	\$10 (3.5") \$60 (8") \$150 (19")	Any object	No
Capacitive [1]	 <p>Huawei Ascend, Sanyo Zio, Apple's iPhone, HTC Hero, DROID Eris, Palm Pre, Blackberry Storm</p>	\$100 (8") \$160 (19") \$310 (32")	Finger or active stylus	Yes
SAW [1]		\$500 (15") \$850 (19") <small>*includes touch screen and LCD monitor</small>	Any object	Yes
Infrared/Optical [1]	 <p>Samsung U600 (heat), Neonode N2 (optical)</p>	\$130 (8") \$250 (19") \$320 (26")	Any object	Yes

# Works Cited

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2. <http://www.planarembded.com/technology/touch/>
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